M.Sc. Construction Economics and Management

Bidding procedures - Tendering policies in construction

Application of bidding models in Greek construction industry

by

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4. Tendering processes in Greece

5. Data analysis
Application of Wanous's model in the Greek construction industry

6. Model results testing – Conclusions

ABSTRACT

In an effort to uncover the main factors that characterize the multiple stages of bidding decisions regarding construction firms, this report can be considered in general as an investigation on bidding procedures and models and their applicability in Greek construction industry. The main objectives set are to identify and validate the key determining factors of tendering processes and their importance weights by presenting survey findings of 5 Greek construction companies of similar size, located in Athens.

Primary focus is based on the pre-existing surveys and models based on parametric solutions, such as the Wanous et al, (2000), model, aiming to the optimisation of their utilisation and their application to Greek construction sector. Through this process, a new model was created, based on data from 25 real-life bidding situations. This model was tested in 10 additional projects, resulting to an accuracy of 80% in predicting the companies' decision towards the bid/no bid dilemma. Despite the fact that the model was based on input provided by a specific type of contractors, it is believed that the overall approach, reasoning and findings of the proposed framework can be considered as an important structural tool to Greek contracting organizations in general and, if adjusted accordingly, can add value to the contractors' benefits.

Keywords: Tendering processes, bidding models, bid / no bid dilemma, key influential factors, private / public projects, auctions.

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INTRODUCTION

The decision whether to bid or not is considered as one of the most important issues influencing a contractor firm's performance, and, consequently, the firm's revenues and profits. According to Johnston and Mansfield, (2001), this decision can be summarized as: "Is the project to bid the kind of work our company has been successful at completing to the owner's satisfaction, and will our company make a reasonable profit from that work?" So, the decision is not only considering the probability to win the tender but is also taking into account the latter part, which is being able to finish the job as planned and with the expected profit.

1.1 Identification of the problem

For a contractor, deciding whether or not to submit a bid for a new project is a highly complex process. In a large company, it is usually undertaken by an optimal combination of members of the senior management, who confront the projects strategically exploring their profit capacities, and members of the on-site managers, who are mostly focused on deciding whether the under discussion project is practically and technically feasible for the company's potentials (Harris and McCaffer, 2001).

It is a fact that bidding on unsuitable projects could result in a large loss or consume time and resources that could be invested in more profitable projects. Especially in construction industry, where each project's direct and indirect costs are considerably higher than those of other industries, this can result in cost overruns and brand name's damage that cannot be easily withstanded from the company. On the other hand, not bidding for a project could result in losing a good opportunity to make profit and improve the contractors' strength in the industry and market share, and gain a long-term relation with a new client (Wanous et al, 2003).

Practice has shown, though, that contractors usually rely on their experience and their guessing capabilities, and make their decision on whether bidding or not, not being based on any specified strategic thinking approach, but mostly intuitively (Fayek, 1998). However, the increasing complexity of these issues guided to the need for the creation of a platform which would aid contractors in order to decide whether to bid or not for a new project, after an invitation to tender has been received. In other words, the need was highlighted for a structured and realistic model, which would gain acceptance in practice and deal systematically with different bidding situations and assist the contractors in reaching the correct decisions.

1.2 Objectives of the research study

The present study represents an analysis of the factors that influence the bid/no bid dilemma, through a survey undertaken to 5 middle-size Greek construction companies. This research retained the concept of a previously undertaken study by Wanous et al, (2000), in Syrian contractors, however its methodology and objectives were adjusted to the Greek construction industry.

Specifically, the objectives were:

- The extent to which the Wanous et al,(2000), parametric bidding model can be applied to the above stated Case Studies in Greece.
- The identification of the factors that critically affect bidding decisions of the above stated Greek Construction Companies.
- The proposal of alterations required through the formation of a new bidding parametric model, more applicable in Greek Construction Companies.
- The comparison of critical factors found in Greek construction industry with ones found in Syrian Construction Industry - Conclusions drawn regarding Greek Bidding Policies.

1.3 Structure of the research study

Firstly, in Chapter 2, the general research question of the research is investigated through the existing literature. Identification of models which addressed to the bid/no bid question is done historically, referring to the most innovative and significant approaches that were undertaken, as well as to their limitations observed. The literature review is followed, in Chapter 3, by the analysis of the Wanous et al's, (2000), parametric model, underlining the main concept of the model, and identifying the parts that are of particular interest in order to examine the alterations required for its application to the Greek construction sector.

Following, in Chapter 4, research extends to the existing state of thought of Greek construction companies, along with the research of the Greek Law System in terms of the categorisation of projects based on their private or public nature, since the legal aspect of this issue depending on each country is different. This projects' categorisation is necessary in order to proceed in Chapter 5, which is mostly concerned with the survey undertaken in the Greek construction sector. In this chapter, the analysis of the questionnaires under the Wanous's 'prism of thought' is presented, identifying the factors that influence the bid/no bid decision for the companies questioned, and the effect each of those factors has to the final decision taken, and, ultimately creating a new model adapted to the Greek environment.

Finally, the last chapter 6 includes the new model's testing through two new companies, its comparison with the Wanous's one and conclusions and recommendations drawn from the research process regarding the way Greek construction industry functions in general, and the model's utilisation and optimisation in particular.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

It is a fact that contractors' bidding behaviors are affected by numerous factors related both to the specific features of the project and to certain dynamically changing situations. Thus, bidding decision problems are usually highly unstructured. According to Chua et al, (2001), bidding can be considered as a very complex issue that requires simultaneous assessment of large number of highly interrelated variables to arrive to a decision. Since it represents such a sensitive issue for the company's performance, it is usually assigned to the higher level management team, whose task is to take into consideration all the related factors and their combined impact for bid/no bid and mark-up decisions in the limited amount of time they have for every single tender offer (Deng, 1994).

2.2 Bidding models - Relevant history

Dealing with theoretical frameworks concerning bidding models, one can come across interesting creations. However, most of them proved either inadequate, or inappropriate in predicting the company's decisions within an acceptable level of accuracy. It is a fact, that it is difficult to develop realistic models that can capture the complexity and uncertainty of the full construction contract bidding situation. The complexity of the problem, regarding the decisions in bidding stage, is so overwhelming that even the experienced contractors feel that the industry should have a better technique for arriving at bid/no bid decisions (Egemen and Mohamed, 2005).

2.2.1 Bidding models developed in 1950's and 1960's

In terms of referring to the best bidding models that have existed during the latest years, one can start with Friedman's, (1956), mathematical model, followed by Gates's model in 1967.

Main concept: These were both theoretical mathematical studies, mostly focused in highlighting the uniqueness of characteristics in each bidding situation and the different, and not standardized, treatment that is required. Each model presented a mathematical method that determined optimum bids in a competitive-bidding situation where each competitor submitted only one closed bid. They undervalued the essence of the number of bidders, which could be large or even unknown (Stark and Rothkopf, 1979).

Limitations: The studies, as developed, were academically and scientifically adequate, however not practically feasible. The multiple variables included in the analysis, along with the necessity of viewing each case as unique, reduced the standardization of processes, and increased the models' complexity. Contractors, however, are generally task orientated and operate through standardized processes and norms. This fact, along with the "experiential" approach, (based on their subjective expertise judgment), of most contractors towards tendering procedures prevented them from accepting the usage of those mathematical models that would aid them in their dealing with bidding situations (Eldukair, 1995).

2.2.2 Bidding models developed in 1980's

These two first attempts were followed by Ahmad and Minkarah's work in 1988, where they conducted a survey to uncover the factors that affected the bidding decision making process in the United States. According to their survey, 31 factors were identified and rated according to their influence on this procedure. Based on the results of the above stated survey, Ahmad, (1990), adopted a utility value approach and proposed a bidding methodology based on the decision analysis technique for dealing with bid/no bid problem.

Main concept: This model considered the bidding problem as a two stage problem. One is a deterministic stage that concerns the bid/no bid decision. The important criteria considered in this stage are deterministic and certain, such as type of project and location. The second stage is probabilistic because the criteria considered in it are

uncertain, such as competition and risks expected. The bidding problem was decomposed into four high level criteria and 13 lower level criteria.

Limitations: Ahmad's model is considered as the most promising effort until the 1990's, since its practicality and feasibility were tested upon real-life problems with satisfactory results. However, its practicality was also widely criticized because of the arbitrary choice of assuming that all factors have a positive contribution to the decision making process. In other words, there was a positive scale of marks upon which all factors were based, neglecting the fact that there can exist negative factors that might discourage the company from submitting a specific bid; consequently the negative influence of those factors had to be measured as well (Dawood, 1995).

2.2.3 Bidding models developed in 1990's

After the 1990's, several models were developed. Indicatively should be referred Seydel and Olson's, (1990), model, which referred to the competitive bidding problem according to three main factors; profitability, risk exposure and continuity, along with Moselhi et al's model, (1993), who developed a decision support system for correct mark-up estimations. The most promising ones, however, were Shash's, (1993), and Dozzi et al's, (1996), models. The first was the continuity of Ahmad and Minkarah's survey and identified and ranked 55 factors that characterize bidding decisions in United Kingdom. The second was a utility theory model for bid decision and mark up determination using 21 criteria in this decision.

Main concept: These two rather recent types of models, focused in the creation of a database management program that retrieved historical information from past bids submitted by the company and its competitors. After information had been gathered, the program processed the outcomes through its knowledge base, providing the company with a bid/no bid recommendation for a specific project.

Limitations: However, the inadequacy of these models was observed as well. This time, the models' inaccuracy occurred due to the lack of categorization of the projects

according to their sizes. The companies were categorised according to the number of projects they had fulfilled during the past five years, creating simultaneously the necessity for historical information for the general applicability of the model, a fact that is not always feasible (Chua, Li and Chan, 2001).

2.2.4 Recently developed bidding models

Reaching nowadays, the most promising attempt of creating a bidding model that would refer to the real characteristics of construction industry was conducted by Wanous et al, (2000). This model was created as a result from a survey among Syrian contractors, that was conducted by Wanous et al, (1998), which uncovered the parameters that characterize the bid/no bid decision-making process. These parameters, after being ranked according to their importance, as well as to their effect, in the bid/ no bid dilemma, were inserted into a mathematical equation that would come to a conclusion regarding the best possible decision for the company's interest.

Wanous's model represents an important tool for bidding processes and its main structure is followed as a research methodology for the present study, in order to identify the changes required for the formation of a relevant model for the Greek construction industry. For this reason, a deeper analysis of the Wanous's model is undertaken in the following chapter.

2.3 Summary

Summarising the above, it is a fact that review has shown that various bidding approaches have been developed in an effort to provide an accurate assisting tool for contractors towards their bid/ no bid dilemma. However, most of them proved relatively ineffective in predicting accurately the company's decisions. For this reason, the present study is based on the structure of a more recent approach, the Wanous et al's, (2000), model, in order to examine through that prism the possibility of creating a model of similar nature in the Greek construction sector.

RESEARCH METHODOLOGY

THE WANOUS ET AL, (2000), PARAMETRIC MODEL

3.1 Introduction – Scope of the study

The present thesis employs both a qualitative and quantitative study regarding bidding processes in general, and the way they may be approached through the creation of a bidding model which will be based on the existing literature regarding bidding models, and especially on the Wanous et al, (2000), parametric model.

3.2 Methodological approach of the present study

As already stated, the study's nature can be characterized as both qualitative and quantitative. The qualitative aspect of the study is investigated through the first stages of two questionnaires (Questionnaire A – Stage A, Questionnaire B – Stage A) that are included in appendix. In those stages, the aim is to reveal the attributes of bidding processes in Greek construction industry, achieving a more holistic perspective of the companies questioned, and the state of thought of Greek contractors in general.

On the other hand, the quantitative aspect of the study is investigated through the second stages of the same questionnaires (Questionnaire A – Stage B, Questionnaire B – Stage B), where the identification of factors affecting the bid/ no bid dilemma is achieved. Those factors are measured (on a mathematical scale) both in terms of their importance and of their effect to the bidding decision. However, the quantitative methodological approach of this study was undertaken following the steps of Wanous et al's, (2000), model, from the initial determination of the factors, to the equation used for the model results; thus, at this point, a more in depth description of the characteristics of Wanous's model is necessary.

3.3 The Wanous et al, (2000), parametric model

As previously stated, Wanous's model was created following a survey among Syrian contractors, undertaken by Wanous et al, (1998), which identified the 35 parameters that characterize the bid/no bid decision-making process, according to their relative importance. Those parameters are depicted in table 1 below.

Table 1: Bidding factors that are considered in developing the model

Bid/no bid criteria	Ib (%)	Factors considered to have moderate to high importance
Fulfilling the to-tender conditions imposed by the client	89.88	*
Financial capability of the client	77.67	*
Relations with and reputation of the client	76.83	*
Project size	73.17	*
Availability of time for tendering	70.83	*
Availability of capital required	68.33	*
Site clearance of obstructions	68.00	*
Public objection	67.83	*
Availability of materials required	66.33	*
Current workload	65.83	*
Experience in similar projects	64.00	*
Availability of equipment required	64.00	*
Method of construction (manually, mechanically)	64.00	*
Availability of skilled labour	58.00	*
Original project duration	55.50	*
Site accessibility	53.83	*
Risks expected	52.17	*
Rigidity of specifications	50.00	*
Expected project cashflow	47.00	
Degree of buildability	47.00	
Availability of other projects	46.17	
Confidence in the cost estimate	45.33	
Project location	31.67	
Original price estimated by the client	28.50	
Past profit in similar projects	26.50	
Expected date of commencing	24.67	
Availability of equipment owned by the contractor	22.17	
Expected number of competitors (degree of competition)	17.83	
Local climate	17.50	
Specific features that provide competitive advantage	16.33	
Fluctuation in labour/materials price	15.00	
Competence of the expected competition	12.50	
Relations with other contractors and suppliers	10.33	
Proportions to be subcontracted	5.50	
Local customs	4.17	

(Source: Wanous et al, 2000)

The ranking of those factors resulted through scoring their importance by contractors with a score between 0 (extremely unimportant) and 6 (extremely important). Their importance is expressed in a percentage scale in the second column with the indice Ib. (e.g. the "Fulfilling the to-tender conditions imposed by the client" factor was ranked with 5.39/6 as an average, thus this was transformed to Ib= 89.88%).

The Wanous et al, (2000), model was created based on the outcomes of survey. It can be considered as a simple parametric solution for the bid/no bid decision, that took into consideration in the development process the 18 most influential factors (the ones with a percentage of importance above 50%) among the total of 35. Those factors are highlighted in table 1 with an asterisk, in the 3rd column. The model was optimized using data about 162 real bidding situations. Then the optimized model was tested in another 20 real projects. It finally proved 85% accurate in simulating the final company's decision towards the bid/no bid dilemma.

3.3.1 Methodology of the model

The model was based on six semi-structured interviews conducted among contractors who had considerable experience in the Syrian construction industry. A formal questionnaire was designed to uncover the factors that characterize the bidding decisions in Syria and to find out how these factors affect the bid/no bid decision. Factors were categorised according to their influence to the bidding process as positive or negative ones, where positive factors encourage companies to bid, and negative ones discourage company from bidding. The categorization of the factors according to Wanous's state of thought is displayed in table 2 below.

Table 2: Categorization of the factors that affect the bidding decision

Positive bidding factors	Negative bidding factors
Fulfilling the to-tender conditions imposed by the client	Project size
Financial capability of the client	Public objection
Relations with and reputation of the client	Current work load
Availability of time for tendering	Risks expected
Availability of capital required	Rigidity of specifications
Site clearance of obstructions	
Availability of materials required	
Experience in similar projects	
Availability of equipment required	
Method of construction (manually, mechanically)	
Availability of skilled labour	
Original project duration	
Site accessibility	

(Source: Wanous et al, 2000)

At this point it should be noted that the classification according to Wanous into two groups represents an artificial way of categorizing the above stated factors, that depicts the general influence of each factor on the bidding procedure, indicating that an increasing score in a positive recommendation strengthens the bid recommendation, whereas an increasing score in a negative factor weakens the recommendation decision. As obvious, a low score in a positive factor may also weaken the bidding decision, and also a low score in a negative factor may strengthen the decision.

3.3.2 Data analysis of the model

After identifying the factors that mostly affect the bidding decision, the model proceeds with ranking the above stated parameters with statistical analysis of the results from the questionnaires. More specifically, there are two variables that are estimated for each factor (positive or negative) numerically and on a scale from 0 to 6. The first is the parameter B*i* which is a neutral score below which each factor has a discouraging effect on the bid decision and the second is NB*i* which is a "kill value", which represents a score below which the factor is enough in order to cause a no bid recommendation. Under a similar perspective, the negative factors are also ranked according to two variables. The first is the parameter B*j* which is a neutral score above which the factor will have a discouraging effect on the bid decision, and the second is NB*j* which is a kill value above which this factor will be enough to cause no bid recommendation.

For reasons of clarity of the results, after estimating the neutral and kill scores of the above stated factors, Wanous creates a simple parametric scale for each of them (positive or negative), as depicted in the following figures 1 and 2, in order to explain how each of these factors affect the bidding recommendation.

Figure 1 : Parametric scale for the positive factors

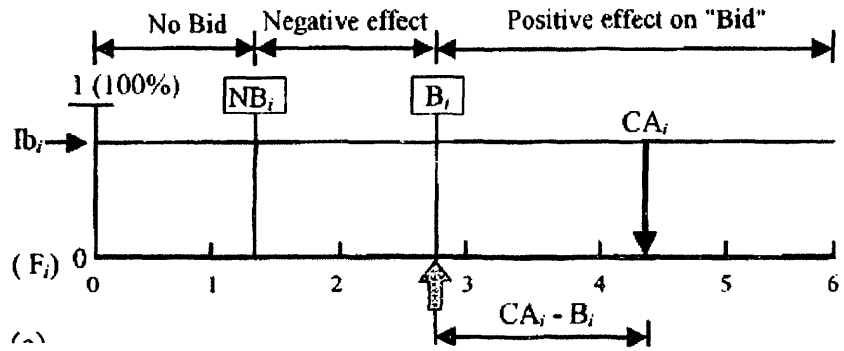
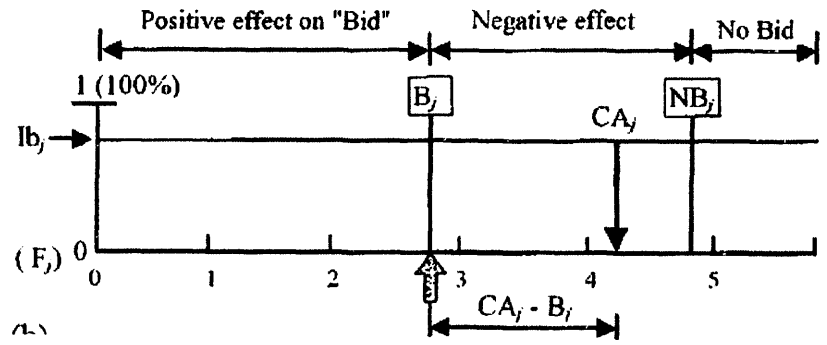


Figure 2 : Parametric scale for the negative factors



(Source of both figures: Wanous et al, 2000)

- In the above displayed figures, positive factors are represented with F*i*, while negative ones with F*j*. As obvious from table 2, F*i* E for i(1-13), while F*j* E for j(1-5).

- *Ii* is the importance index of factor F*i*, I*j* is the importance index of factor F*j*. Numbers for both those parameters are given in table 1, where they are displayed as Ib.

- CA*i* is the contractor's assessment given to F*i* (score between 0 and 6) and CA*j* is the contractor's assessment (score between 0 and 6) given to F*j*.

As obvious, the above stated example was used in order to produce a better image on the results of the survey. In the above stated parameters, the unknown variable is the contractor's assessment (CA*i* and CA*j*). If the contractor's assessment of a positive factor is above Bi, its positive contribution to the final decision will be numerically measured as CAi-Bi (see figure 2). Similarly for negative factors, if the contractor's assessment of a negative factor is above Bj, its negative contribution to the final decision will be numerically measured as CAj-Bj (see figure 2).

It should be stated that in the above scales, the significance of "kill values" is highlighted and easily understood. Specifically, if the contractor's assessment is estimated below NBi for a positive factor (figure 1), or above NBj for a negative factor (figure 2), then the model automatically comes to a "no bid" decision and no further analysis is needed. Whereas if the contractor's assessment is estimated between NBi and Ni for a positive factor, or below Bj for a negative factor, there is observed the "reversion" of roles; in other words, the factor defined as positive has a negative effect, and the factor defined as negative has a positive one.

3.3.3 Model results

Taking into consideration the above stated features, Wanous managed to include all factors in one equation, which would determine the company's decision regarding the bid/no bid dilemma. Thus, the following equation was created, producing a bidding index (BIk) for a certain project k.

Equation (A) : Formula of bidding desirability

$$BI_k = \sum_{i=1}^{m} Ib_i(CA_i - B_i) - \sum_{j=1}^{n} Ib_j(CA_j - B_j)$$

In the above formula BIk essentially indicates the numerically expressed desirability of bidding on project k. Regarding the indices (m) and (n), those are the parameters indicating the number of factors, (m) stands for the positive factors, which in

Wanous's model are 13 and (n) for the negative ones, which are 5. All the rest variables are already previously defined.

3.3.4 Step-to-step the process followed

Step 1: The contractor is requested to describe the under research bidding project by assigning a suitable score (CAi and CAj) between 0 (extremely low) and 6 (extremely high) to each bidding factor.

Step 2: The contractor checks if any factor violates its pre-estimated kill value, since, in this case the process stops and the model automatically recommends a no bid decision.

Step 3: Using equation (A) the model produces the bidding index (BIk).

- If BIk > 0 then the bid decision is recommended.
- If BIk < 0 then the no bid decision is recommended.
- In the particular case where CAi = Bi and CAj = Bj, then BIk = 0. That represents the mid-point case scenario where no result can occur from the model, in other words the potential risks are equalized to the potential benefits from the specific project. This subjective conclusion should, however, be taken into consideration by the contractor before coming to a decision towards his actions.

Final step 4 : The contractor decides whether to bid or not taking into consideration the model's results, as well as any unforeseen parameters that were not included in the model's analysis and may, according to him, affect the project's performance.

TENDERING PROCESSES IN GREECE

4.1 Introduction

The Greek construction industry has been a sector of Greek economy with the most significant evolution over the recent years. Even though its character is still dynamically changing, adapting to European as well as globally set standards, there is a norm of thoughts and rules nowadays applied, that may be representative of the way the industry functions and the various projects are delivered successfully.

4.2 General characteristics of projects in Greek Construction Industry

Projects in Greek Construction Industry have a major characteristic that distinguishes them depending on the nature of the client they address to, and this separates them into public and private projects. As observed, a further analysis based on this discrimination is indispensible, since the strategy followed by construction firms differs significantly whether the project has a public or private character.

4.2.1 Private projects

Private projects are considered the projects that are funded by private clients and companies, obeying to the supply and demand law of the market. "As a private project may be defined, in contradiction to a public one, a project that covers the needs of one or more individuals, and the assignment of which is done by individuals or companies that do not belong to the public sector." (NGG, law n.1577/85).

Regarding private projects, there are not any characteristics that appear in Greek construction industry in particular, that are not confronted in other nations' industries. They generally obey the law of antagonism and the usual practice is that after an invitation to tender has been received by the contractors of the client's choice, the winner of the competition is the lowest bidder; the client starts by calling a high price

and prices descend. This procedure does not follow any specific rules that can function as a norm, since the client/seller can choose which type of auction will serve best his own interests. Thus, the auction may be either open or sealed, the other bids may be observed or not, and also the potential of re-bid or not depends on the client's perspective; in other words, how much he wants to reduce cost with acceptable effects on time overruns and quality reductions (following the "iron triangle" state of thought, as Neal, 1995, states where the company's performance is portrayed inside a time, cost and quality prism).

4.2.2 Public projects

Public projects are considered the projects that are funded by the Greek Government, the local councils, or the European Union. "As a public project may be defined a project that covers a basic need of the society, that contributes to the development of public activities, that contributes to the increase of the country's Gross Domestic Product, that increases the nation's safety and that generally focuses to the optimization of the quality of life of the people." (NGG, law n.1418/84). Public projects, in contrary to private ones, are much more specified, since the client is usually the Greek Government. For a better understanding of processes in auctions of public projects in the Greek construction sector, and the problems that might be confronted while dealing with them, an analysis of the historical evolution of those auctions is helpful.

4.2.2.1 Auctions of public projects in the Greek construction industry:

Period 1974-1998

After 1974, when the military dictatorship was removed and the regime of chaired democracy was re-established in Greece, public projects were subject to open auctions without invitations to tender and the contractors were categorised according to their grade of construction certificate. The grades were awarded depending on the experience and the successful accomplishment of past projects by contractors, and addressed to the type of projects they were able to undertake. Grade scale was from 1 to 7, with grade 1 being the lowest and awarded even to a single professional (e.g. a civil engineer) the time he obtains his degree and starts his professional career.

According to this state of thought, the Greek Government auctioned projects and awarded the lots following the law of competition to the lowest bidder (Xirotiri, 2003).

However, the above stated procedure of auctioning public projects had several difficulties. It was an undisputable fact that the process of awarding the auctions having as a sole criterion the price of the tender guided to malfunctions regarding the projects' performance. The reason was simple: It became usual practice that the lowest price was not always mathematically feasible. Thus, the price the project was sold might have been low, but cost, quality and time overruns were usually unavoidable. This was attributed to multiple facts such as miscalculations and mistakes of contractors, overestimations of their capacities of reducing costs, or even experienced cashflows and reduced workloads that forced them to bid low for a project in order to win the auction and be "back in business" (Boukouvalas, 1999).

4.2.2.2 Auctions of public projects in the Greek construction industry:

Period 1998-2005

The above stated malfunctions, forced the Greek State and the Ministry for the Environment, Physical Planning and Public Works, in 1998, to change the law regarding public projects. The new law (NGG, law n.2576/98), called the "mathematical model" involved the use of complex mathematical equations which would conclude to the best feasible solution, however not necessarily the cheapest one. This process was based on the potential of reaching to a conclusion regarding the lowest possible cost of the whole project, an estimation that occurred mostly from the average prices of the tenders in total, that would not jeopardize the successful undertake of the project. The main goal was to avoid awarding the lot necessarily to the lowest bidder for the reasons mentioned above, and, in the same time to sell the job to a satisfactory price for the Greek Government (Zouraris, 2001).

Practice showed that even though this plan was theoretically correct, it did not function as scheduled either. It is a fact that influencing the auctions became much more difficult; however contractors managed to find ways to corrupt the process for their own interests. This happened mainly through routes of multiple tendering, which were supported by each contractor, a fact that influenced the average prices of the tenders to which the model concluded, forging the model results regarding the winning bid.

4.2.2.3 Auctions of public projects in the Greek construction industry:

Period 2005 - Present

For this reason a new law was introduced in 2005 (NGG, law n.3316/05), which is valid until nowadays, that returned to the past, having as a sole criterion the tender's price, awarding the lot to the lowest bid. However, certain other parameters of the above stated law improved the situation greatly, since nowadays are demanded by the State much higher financial guarantees from contractors, in order to consider a tender as valid, and also the technical description of each project is much more detailed than in the past. These two measures reduced considerably the number of unfinished projects due to wrong cost estimations during the bidding process that was noted before, since contractors became more reluctant towards the discount on their tender prices and also the space for subjectivity to their cost calculations was limited (Korres,2006).

CHAPTER 5

DATA ANALYSIS - APPLICATION OF WANOUS'S MODEL IN GREEK CONSTRUCTION INDUSTRY

5.1 Introduction

As already stated, the ultimate goal of this research is to investigate the degree of applicability of the Wanous's model to the Greek Construction Industry, and adjust any alterations required in order to increase the model's accuracy. For this reason, a survey was undertaken among five Greek construction firms that involved five different projects for each company. The steps followed were according to Wanous's methodology; all changes required are identified and explained below.

5.2 Contractors' responses - Analysis

5.2.1 Step 1: Responses in terms of the importance of the factors that influence the bid/no bid dilemma – Questionnaire A

The first step of the analysis is to identify the critical parameters that affect the bidding decision in Greek Construction Companies. In order to achieve that goal, a two-stage questionnaire was formed and filled by each of 5 companies questioned.

5.2.1.1 Questionnaire A – Stage A: Case Studies

General information regarding companies questioned

The first stage (as depicted in Questionnaire A in appendix) included general information regarding the companies' workforce, the main activities they are focused to and their general performance in terms of revenues and profits. In terms of the auctions to which they participated, information is required regarding the number of invitations to tender they had received during the year 2006, along with the tenders submitted and the number of competitions won. It should be stated here that the sample of the companies taken was carefully selected, in order to involve companies

of generally similar characteristics and growth. This was done since a survey within significantly diversified companies that differ considerably in profits, growth, number of employees or market share, could jeopardize the reliability of the results of the research due to different targets and perspectives within the companies of the sample itself. The results of the first stage of the survey that display a "portrait" of the companies questioned are summarized in table 3 below:

Table 3: Characteristics of the companies that participated in the survey

Company's Name	ALPHA	BETA	GAMMA	DELTA	EPSILON
Incorporation Date	1996	1988	1995	1999	1990
Nature of projects	Private sector	Private sector	Private sector	Public sector	Private sector
Main activities	Residential Buildings	Residential-Commercial Buildings	Residential Buildings	Commercial-Industrial Buildings	Residential-Commercial Buildings
Employees	1-10	1-10	1-10	1-10	1-10
Engineers	2	2	3	2	3
Construction Certificate	3rd Grade	4th Grade	3rd Grade	4th Grade	4th Grade
Revenues during 2006	Between 500,000 and 2,000,000 €	Between 500,000 and 2,000,000 €	Between 500,000 and 2,000,000 €	Between 2,000,000 and 5,000,000 €	Between 500,000 and 2,000,000 €
Profit during 2006	Between 100,000 and 500,000 €	Up to 100,000 €	Between 100,000 and 500,000 €	Between 100,000 and 500,000 €	Between 100,000 and 500,000 €
Invitations to tender during 2006	10-15	5-10	10-15	15-20	10-15
Tenders submitted during 2006	5-10	5-10	10-15	10-15	5-10
Competitions won during 2006	1-5	1-5	1-5	5-10	1-5

(Source: Data obtained from answers to **questionnaire A – Stage A** in appendix)

As obvious from the above table, the real names of the companies were not stated, following the demand of the contractors questioned, since, according to them, the information given is considered confidential and not subject to publication. It is only given for the purposes of the research.

An interesting observation, at this point of the analysis, is that averaging out the characteristics of the companies questioned, as analysed in the previous table, certain conclusions can be drawn regarding the sample's "representative" firm as stated by Marshall, (1961), that the present model addresses to.

Adopting Moss's, (1984), definition, "as a representative firm could be concerned, according to Marshall, an imaginary construct not corresponding to the characteristics of any real firm whatsoever. It should be probably treated as the 'conflation of the life-cycle of actual individual firms' averaging out the firms' characteristics such as cost, profitability, and output.". However, in our case, the representative firm of our model has several characteristics, the identification of which is of critical importance, since it both depicts:

- The average characteristics of the companies to which the model was based.
- The preferable characteristics of the companies that may find the model as a useful tool to optimize their performance.

Thus, the characteristics of our representative company are averaged and summarized in table 4 below:

Table 4: Average characteristics of the sample's representative company

REPRESENTATIVE COMPANY	
Incorporation Date	1990-1995
Nature of projects	Mostly private sector
Main activities	Residential – Commercial Buildings
Employees	1-10
Engineers	2-3
Construction Certificate	3rd to 4th Grade
Revenues during 2006	Between 500,000 and 2,000,000 €
Profit during 2006	Between 100,000 and 500,000 €
Invitations to tender	Approximately 10-15
Tenders submitted	Approximately 5-10
Competitions won	Approximately 1-5

(Source: Data averaged from table 3)

5.2.1.2 Questionnaire A - Stage B:

Importance of factors that influence the bid/no bid dilemma

The second stage of questionnaire A aimed to highlight the significance of each of the factors included in Wanous's model, on a factor-by-factor level, adopted into the standards of the Greek construction Industry. This process, however, included 24 out of the 38 parameters stated in Wanous's model, which were to be marked according to their relevant importance for each firm on a scale from 1 to 6 (where grade 1 would represent a parameter of almost zero importance in the company's decision whether to bid or not, and grade 6 of highest importance). The remaining 14 factors were omitted for three main reasons:

- Either their significance was too undervalued by the contractors during the first discussion, thus they would add to the model's complexity without, essentially, adding any value to its accuracy.
- Or they were too similar and complementary to other factors of the model, guiding to misconceptions and, thus, to inaccurate model results
- Or they did not have any applicability to the Greek construction industry, and could not be rated by contractors in an importance scale.

Also, there were left 3 blank spaces in the questionnaires in order to allow the potential of adding a parameter (critical or not), that would not be included in the above list.

According to the above stated process, the significance of each parameter was measured on a 1 to 6 scale and transformed to a percentage of importance Ib. The goal is to estimate indices Ib_i and Ib_j as they are depicted in Equation A. In table 5 that follows are displayed all the parameters that were included in the survey. The ones found to be of moderate to high importance, (their average grade was from 3.5 to 6, thus from 50% to 100%), are highlighted with an asterisk on the 3rd column. This is done in order to demonstrate the factors that will be included to our analysis in order to simplify the final model as much as possible, and to follow the Wanous's state of thought.

Table 5: Bidding factors that affect the bid/no bid decision in Greek construction industry

A/A	Bid/no bid parameter	Relative importance **Ibi** or **Ibj**	Factors considered to have moderate to high importance
A	Financial capability of the client	96.67%	*
B	Past experience/profit in projects of similar nature	96.67%	*
C	Specific features providing competitive advantage to firm	93.33%	*
D	Risks expected	93.33%	*
E	Relations with and reputation of the client	90.00%	*
F	Fulfilling the to-tender conditions imposed by the client	86.67%	*
G	Expected quantity and quality of competitive bids	83.33%	*
H	Relations with other contractors and suppliers	76.67%	*
I	Availability of critical equipment required	73.33%	*
J	Availability of critical materials required	70.00%	*
K	Site location	66.67%	*
L	Availability of capital required	63.33%	*
M	Project size	60.00%	*
N	Local climate	53.33%	*
O	Availability of skilled labour	46.67%	
P	Current work load	43.33%	
Q	Site accessibility	40.00%	
R	Public objection	40.00%	
S	Site clearance of obstructions	36.67%	
T	Availability of time for tendering	33.33%	
U	Original project duration	33.33%	
V	Confidence in the cost estimate	26.66%	
W	Availability of equipment owned by the Contractor	23.33%	
X	Local customs	16.66%	

(Source: Data obtained from answers to **questionnaire A – Stage B** in appendix)

As obvious from the above table, the Greek construction industry is operating under a different state of thought from the Syrian Construction Industry upon which Wanous's model was tested. Thus, the parameters affecting the bid/no bid decision differ in multiple ways in our case.

A critical clarification at this point is to underline that in Wanous's model the factors, as included in table 1, are not explained in detail. Thus, a more in depth description of each of the factors as listed in table 5 above, is indispensible. The main goal, however, is not to try to interpret the way the authors of the Wanous's article described the factors during their survey, but to analyse the way the factors were explained to the Greek contractors that answered to the questionnaire of the current survey, in order to have a better perspective in terms of their responses.

5.2.2 Description of the factors affecting the bid/no bid dilemma

The analytical description of each of the factors included in table 5 (the ones of moderate to high importance, from A to N), is a result from the 5 interviews with the contractors, and represents the way they were identified and explained to them. However, some factors have been viewed, understood and answered through different perspectives by the people interviewed, depending mostly to the position each person had in the company. Obviously, opinions differ greatly whether the person is a technical manager, an entrepreneur, or a sales manager. However the description that follows may be considered as representative of the main concepts that each factor depicts.

A. Financial capability of the client

The first factor refers to the financial capability of the client. In private projects, this criterion is of primary importance and is connected to criterion (E) (Relations with and reputation of the client), since it represents the only realistic guarantee contractors have regarding their payment (funding of the total amount of the project in advance is practically impossible for any client). Obviously, a client whose financial capability is questioned, is not promising as an initiative for the successful completion of a project, thus contractors make efforts to avoid such risky circumstances. Regarding projects of public property, the funding is granted before the project is auctioned by the state. Consequently, the existence of the required money is not questioned. However, the way of the project's payment differs, with some projects being paid off many months after being delivered, thus the way of payment in public works is considered much more critical as an issue, than the financial capability of the state.

B. Past experience-Profit in projects of similar nature

This is also a critical factor that influences the bid/no bid dilemma. A malfunction noticed in a past project of similar nature to the one under discussion may result to a decision not to tender due to fear of repetition of the past problems. Obviously, on the other hand, a very profitable outcome of a past similar project usually results to enforcing the tendering decision.

C. Specific features providing competitive advantage to firm

This factor regards the competitive advantages that each firm considers to have towards the other tenders in terms of a specific project, or series of projects. This criterion is vague, since it includes the firm's core competencies that are usually confidential and cannot be told to a questionnaire survey as the one above. However, even if they were told, the criterion could not be more specific, since its purpose is to include all different competitive features that firms have and cannot be specialized into only one.

D. Risks expected

This factor has also a degree of vagueness since the nature of the anticipated risks that is questioned, is not specified. However, similarly to the above, the different views among the firms and the different strategies followed may include several types of risks, like cost overruns, time overruns, or inability to complete the project; those are primary concerns for the contractors, and can guide to a non-bid decision.

E. Relations with and reputation of the client

This factor, as mentioned, is directly linked to criterion (A). However, its considerable importance has also another explanation which regards primarily public projects. In Greece, political corruption affects all procedures, with public auctions included. Thus, this parameter can be of highest importance for public works, depending on the level to which the company has established good relations with the Government. As obvious, the sincerity of this criterion's answer is doubted for reputational reasons of the firms.

F. Fulfilling the to-tender conditions imposed by the client

This factor's importance is theoretically undisputable, since the inability to fulfill the to-tender conditions should normally prevent contractors from tendering. However, the results of the survey prove that this factor's importance is significant, but not the highest. Here, again, discrimination between public and private projects is necessary. In private projects, the ability of proceeding in tendering without fulfilling the client's

conditions as imposed may be possible, since the subjectivity of the human factor plays a certain role. Thus a tender may be won, even if all conditions are not met by the tenderer, due to certain subjective external reasons. However such a case is not possible in public projects, where the to-tender conditions have to be met in total, or else the tender is considered invalid and does not participate in the auction.

G. Expected quantity and quality of competitive bids

Regarding this factor, there has been a change comparing to Wanous's model. In the Wanous's questionnaire is mentioned only the quantity of competitive tenders. However, after the present survey, it is concluded that much more significant as an issue is the quality of the competitive tenders, since it is this that defines the company's decision. The effect of quality, however, is not easily defined. A general rule, however, is that companies of a smaller size want to participate in a competition with companies of a larger size. The explanation for this is that smaller companies estimate that their profit will be higher (their discount rate will not be large) since larger companies have bigger direct and indirect costs and have reduced flexibility. Thus, their minimum acceptable price is usually lower than that of bigger companies, and they have considerable chances of winning the auction.

H. Relations with other contractors and suppliers

This factor's significance comes from the fact that a project is a complex process that requires the collaboration of multiple professionals. Thus, the quality of relations with other contractors and suppliers depicts the future function of the supply chain of the project and affects the project's performance in general. For most contractors, this becomes of highest importance regarding the decision whether to bid or not, if the project's location is far from the firm's Headquarters (where theoretically relations are better).

I, J, O. *Availability of critical materials, critical equipment and skilled labour*

The alteration in the above stated factors regards the word 'critical'. Wanous's model refers to materials, equipment and labour in general; however the survey in the Greek

construction industry has shown that if the issue is an ordinary project with no special features, then these criteria are of minor importance and do not affect the decision (all contractors have the regular and ordinary equipment and labour). Nevertheless, this factor gains its importance when the material, equipment or labour needed for a particular project is considered rare or expensive. Thus, this 'critical' factor may influence a company's decision negatively or positively depending on the ease of the access the firm has to this particular factor.

K. *Site location*

The place where the site is located represents the factor with the biggest dispersion in the survey. For example, there was a firm that marked it with a 6/6 (highest importance factor) and one with a 1/6 (lowest importance factor). The difference between those two firms is that the first is totally incapable of undertaking projects outside its local surrounding (lack of equipment, vehicles and experience), while the second is organized focusing its strategy on projects in far located and not easily accessible areas, since through those projects their profit is maximized.

L. *Availability of capital required*

Undertaking a project with no pre-existing capital is a standardized process in Greek construction firms. However, the existence of the amounts of capital that is required in order to initiate a project is important for contractors, since it eliminates risks of time overruns during the project's implementation due to unpaid depts. The successful implementation of a project requires, according to contractors, the surplus of capital in order not "to get stuck in the process due to bureaucratic issues" and to achieve the optimal fulfillment of the task.

M. *Project size (on an economical basis)*

In public works, the size of projects that each firm can tender for is restricted according to the firm's grade of construction certificate. Grades exist on a scale from 1 (which is the smallest and an engineer starts with after he obtains his degree) to 7, where companies have to have specific standards, revenues, employees and

experience. In Greece, only 9 construction companies have a construction certificate of 7^{th} grade.

N. *Local climate*

The climate is also a factor that diversified the contractors' opinions. This criterion is mostly dependant on the existence of full-time workers. If a firm occupies full-time workers then that increases the possibilities of bidding for a more risky project in terms of geographical conditions, since there exist probably better health and safety measures taken by the firms and the workers receive additional payment according to the Greek Legal System.

5.2.3 Step 2: Responses in terms of the effect of the factors towards the bid/no bid dilemma - Questionnaire B

The second step of the analysis is to identify the effect (positive or negative) of the factors, as stated in table 5, to the company's final decision whether to bid or not. This step is achieved through a second questionnaire (questionnaire B in appendix) that was filled from each of the 5 companies, but this time for 5 projects from each company. Thus this (also two-stage) second step involved 25 projects in total.

5.2.3.1 Questionnaire B – Stage A:

Information on the projects to which the analysis is based

The first stage of Questionnaire B included general information regarding the projects' process, such as the type of the project under discussion, details in terms of the auction procedure followed, the decision taken (bid/no bid), and the financial success of the project. This information is depicted in tables 6 and 7 that follow.

Table 6: Projects' characteristics

Project characteristics		ALPHA	BETA	GAMMA	DELTA	EPSILON	TOTAL
Project's nature	Public sector	0	0	1	3	1	5
	Private sector	5	5	4	2	4	20
Project's Type	Residential housing	4	3	3	0	3	13
	Commercial housing	0	2	0	2	0	4
	Infrastructure	0	0	0	0	1	1
	Industrial	0	0	1	3	1	5
	Other	1	0	1	0	0	2
Auction Type	Selective	4	5	3	1	4	17
	Non Selective	1	0	2	4	1	8
Auction Process	Open process-Permission to rebid	1	2	1	0	0	4
	Closed process-no permission to rebid	4	3	4	5	5	21
Number of competitors	1-5	1	0	1	0	1	3
	5-10	4	4	3	2	3	16
	More than 10	0	1	1	3	1	6

(Source: Data obtained from answers to **questionnaire B - Stage A** in appendix)

Table 7: Decisions – Process results

Project characteristics		ALPHA	BETA	GAMMA	DELTA	EPSILON	TOTAL
Decision taken	Bid	3	2	3	5	4	17
	No bid	2	3	2	0	1	8
Competition won?	Yes	2	1	2	3	2	10
	No	1	1	1	2	2	7
Project financially successful?	Not at all- Losses experienced	0	1	0	0	0	1
	Marginally	1	0	1	1	0	3
	Very	1	0	1	2	2	6

(Source: Data obtained from answers to **questionnaire B - Stage A** in appendix)

As obvious from the previous tables, in order to reduce the complexity that would occur through the presentation of each different project's answers, projects' characteristics and decision and auction results are categorised according to the companies that they addressed to. Through this process it is possible to have a more holistic perspective regarding the companies' strategies and performance, combining the results as depicted in the charts below, with the characteristics of each company, as stated in table 3.

In the first two charts (figure 3 and figure 4), the projects are distinguished according to their nature and type.

Figure 3: Distinction of projects according to their nature

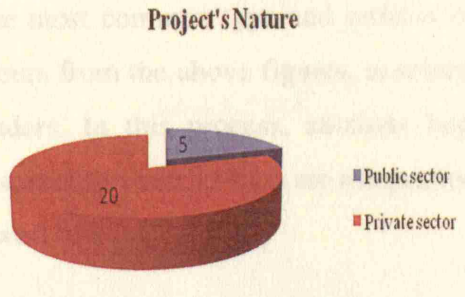
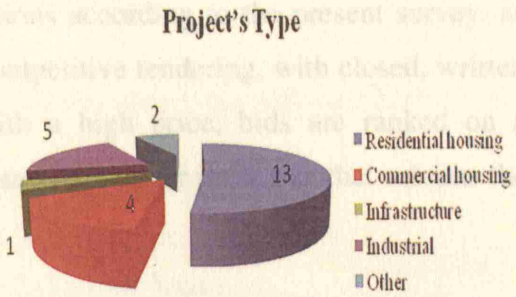


Figure 4: Distinction of projects accorcing to their type



(Source of both figures: Data obtained from table 6)

From the above figures it can be concluded that our model adresses mostly to the private sector, and especially to residential projects. Thus, a straightforward conclusion from the analysis so far guides to the unavoidable necessity of developping a new model that would specialise in the public sector (which mostly includes projects of infrastructure and industrial ones), followed with a possible comparison with the existing one.

The following charts, (figure 5 and figure 6), concern the type of auction followed during the tendering process.

Figure 5: Distinction of auctions according to their type

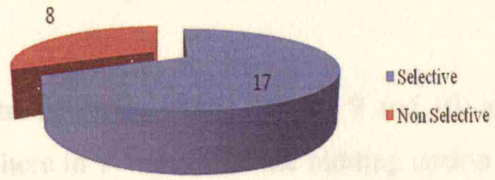
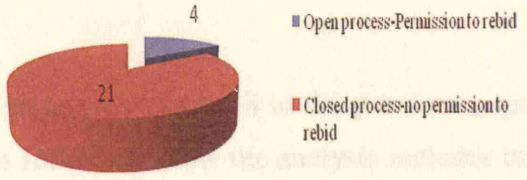


Figure 6: Distinction of auctions accorcing to their process



(Source of both figures: Data obtained from table 6)

The most common type and process of auctions according to the present survey, as occurs from the above figures, is selective competitive tendering, with closed, written tenders. In this process, auctions begin with a high price, bids are ranked on a descending scale, re-bids are not prermitted, and the winner is the one that submits the lowest bid.

The next two charts (figure 7 and figure 8) refer to the characteristics of the auction followed in terms of the competitors that participated and the final decisions taken by the companies towards the bid/no bid dilemma.

Figure 7: Distinction of auctions according to the number of competitors that participated

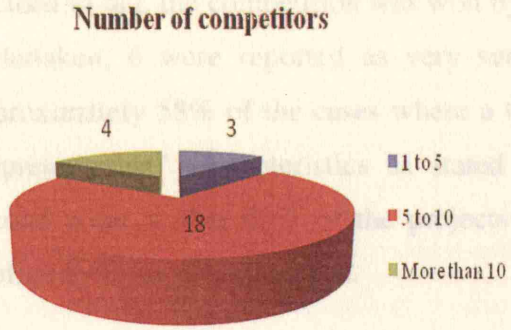
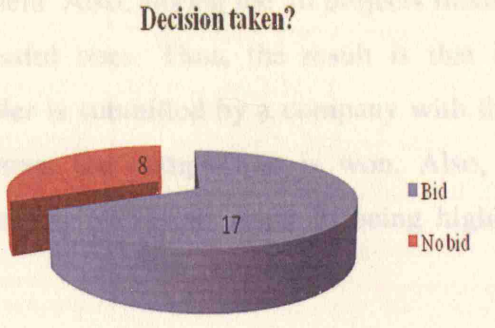


Figure 8: Distinction of auctions accorcing to whether the decision was positive (bid),or negative (no bid)



(Source of both figures: Data obtained from tables 6 and 7)

Thus, according to the previous figures, the most common auction process is that of 5 to 10 competitors, which, as a competitive environment can be characterized as the most promising one in order to strengthen the company's tense towards the bidding option (as observed from figure 8, where in the majority of the cases, the bidding option was preferred).

The final two charts, (figure 9 and 10) are the result of figure 8 in the previous page, where in 17 out of 25 the bidding option was followed. Now the analysis includes the results of the auctions identifying the number of won competitions in figure 9, and the success of the projects that were ultimately undertaken.

Figure 9: Distinction of auctions according to the number of won competitions

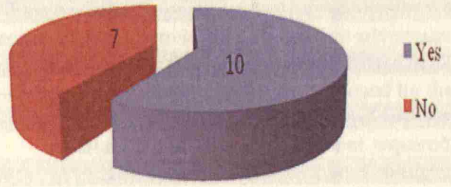
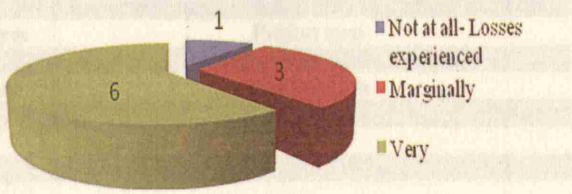


Figure 10: Distinction of project results accorcing to their financial success



(Source of both figures: Data obtained from table 7)

As observed, in 10 among the 17 auctions in which the companies of the sample decided to bid, the competition was won by them. Also, among the 10 projects finally undertaken, 6 were reported as very successful ones. Thus, the result is that in approximately 58% of the cases where a tender is submitted by a company with the "representative" characteristics as stated above, the competition is won. Also, a second point is that 60% of the projects finally undertaken result to being highly profitable for those companies.

5.2.3.2 Questionnaire B - Stage B:

Effect of factors that influence the bid/no bid dilemma

This second stage of Questionnaire B was filled based on the results of the second stage of questionnaire A, and only the critical parameters were included, thus the factors from A to N in table 5. Contractors were asked to rank these factors on a project-to-project basis this time, each for 5 different projects their company had fulfilled after the year 2005 (after the "mathematical model" law was withdrawn).

Factors were ranked now according to the particular effect each had to the final decision whether to bid or not. The distinction of the factors depending on their positive or negative character in table 8 below, is done in accordance to the Wanous's model, however it was adapted to the results of the Greek construction industry.

Table 8: Categorisation of factors according to their effect in the bid/no bid dilemma for Greek construction firms

Positive bidding factors	Negative bidding factors
Financial capability of the client	Risks expected
Past experience/profit in projects of similar nature	Expected quantity and quality of competitive bids
Specific features providing competitive advantage to firm	Project size
Relations with and reputation of the client	Local climate
Fulfilling the to-tender conditions imposed by the client	Site location
Relations with other contractors and suppliers	
Availability of critical equipment required	
Availability of critical materials required	
Availability of capital required	
Availability of skilled labour	

At this point a critical comment needs clarification. It should be stated that categorizing factors as positive or negative ones is a fact of relative subjectivity, since a factor could be either positive or negative to the decision, depending on the perspective under which it is seen by the contractor, and the influence it has on the project-level decision taken. The above categorisation is, as stated, mostly based on the Wanous's state of thought and it is slightly altered according to the results of the preceding survey. However, for purposes of further research, categorisation of the factors can be changed according to the characteristics of the industry the model addresses to.

This second stage included all factors (as listed in table 8) in two different tables (tables B and C in appendix).

- The first table (table B in appendix) involved the positive factors, which were to be marked according to their effect on the project on a scale from 1 to 6 (where grade 1 would represent the fundamentally negative influence the factor has to the decision, and grade 6 the fundamentally positive, in other words the company's competitive advantage for this specific project). It was also asked from contractors to identify for each project the "kill value" of each factor, a grade below which the factor would be enough to cause a no bid recommendation for the company. This is the parameter NBi, as stated in the Wanous's model.
- The second table (table C in appendix) involved the negative factors, also marked according to their effect on the project on a scale from 1 to 6 (where grade 1 would represent the fundamentally positive influence the factor has to the decision, and grade 6 the fundamentally negative one). It was also asked from contractors to assess the "kill value" of each factor, a grade above which the factor would be enough to cause a no bid recommendation. This is the parameter NBj, in the Wanous's model.

The results of the surveys undertaken can be summarized in the following tables 9 and 10.

Table 9: Variables of the positive bidding factors

Positive bidding factors	Bi	NBi
Financial capability of the client	5.63	5
Past experience/profit in projects of similar nature	4.88	4
Specific features providing competitive advantage to firm	5.21	n/a
Relations with and reputation of the client	4.63	n/a
Fulfilling the to-tender conditions imposed by the client	4.73	4
Relations with other contractors and suppliers	4.12	n/a
Availability of critical equipment required	3.78	3
Availability of critical materials required	3.99	2
Availability of capital required	3.22	2
Availability of skilled labour	3.02	2

(Source: Data obtained from answers to **questionnaire B – Stage B** in appendix)

Table 10: Variables of the negative bidding factors

Negative bidding factors	Bj	NBj
Risks expected	3.11	5
Expected quantity and quality of competitive bids	2.34	4
Project size	3.34	5
Local climate	4.11	6
Site location	2.24	n/a

(Source: Data obtained from answers to **questionnaire B – Stage B** in appendix)

The variables of the above tables depict the following:

- **Bi** represents a neutral score *below* which each positive factor will start having discouraging effect on the bid recommendation and was estimated through statistical analysis of questionnaire B (combining data from both first and second stage of the questionnaire).
- **Bj** represents a neutral score *above* which each negative factor will start having discouraging effect on the bid recommendation and was also estimated through statistical analysis of questionnaire B (combining data from both first and second stage of the questionnaire).
- **NBi** represents a kill value of each positive factor, a grade *below* which the factor would be enough to cause a no bid recommendation for the company.
- **NBj** represents a kill value of each negative factor, a grade *above* which the factor would be enough to cause a no bid recommendation for the company

As viewed, in both tables 9 and 10, there appear certain factors that were considered as not applicable (n/a) by the contractors in identifying a kill value grade. This is explained mostly by the subjective nature of those factors. For example in the 'relations with the client and reputation of the client' factor, no kill value can be specified mathematically, since there might exist projects for which a tender was submitted even though the client was totally unfamiliar to the company. Thus, in that kind of factors, even though they might negatively influence the decision, there cannot be a grade specified mathematically that, by itself would prohibit the company from bidding.

5.3 Final step – Model results

Reaching the end of data analysis, the fact is that all factors that are required in order to be applied to Equation A and reach to a conclusion regarding a company's bid/no bid dilemma through the model's process, are identified. For a more holistic view of the model, the equation A, as appeared in chapter 3, is depicted below:

Equation (A) : Formula of bidding desirability

$$BI_k = \sum_{i=1}^{m} Ib_i(CA_i - B_i) - \sum_{j=1}^{n} Ib_j(CA_j - B_j)$$

Summarising the process:

- Parameters Ibi and Ibj that demonstrate the relative *importance* of each *positive* or *negative* factor to the tendering decision of the companies, are estimated in table 5
- Parameters Bi and NBi that demonstrate the relative *effect* and kill value of each *positive* factor to the tendering decision of the companies are estimated in table 9
- Parameters Bj and NBj that demonstrate the relative *effect* and kill value of each *negative* factor to the tendering decision of the companies are estimated in table 10

The possible utilisation of the model (as an aiding tool for a contractor, in order to decide whether to submit a tender or not), can arise through the identification of the only unknown variables that are left in Equation A, which are the contractor's assessments CAi and CAj. These parameters have to be ranked on a 1 to 6 scale in tables B and C in appendix, and then used in equation A, achieving the final goal of the model , the estimation of variable Bik.

Thus, the model results are as following:

- If **Bik > 0**, then the model recommends a decision *to bid.*
- If **Bik < 0**, then the model recommends a decision *not to bid.*

MODEL RESULTS TESTING

CONCLUSIONS

6.1 Introduction

Regarding the last chapter of this research, this can be distinguished in two parts. The first part is mostly concerned with the examination of the model's accuracy in the Greek construction market, through the model's testing in certain projects undertaken by different firms from the ones that guided to the model's creation. The second part includes some conclusions in terms of construction industry and the way it operates in Greece, mostly drawn by the model results, along with the 5 personal interviews undertaken.

6.2 Model results tests

As above stated, the developed model's accuracy was tested through a range of new projects, for which an invitation to tender had been received and either accepted or rejected from construction firms. The criteria for the companies' selection for the model's tests were mainly the ones stated below:

- The decisions answering to the invitations to tender should be already taken (in order to compare the model's bid/no bid decision results to the ones actually happened).
- The companies questioned should not be among the ones that aided in formulating the model, in order to examine the model's application under different "schools of thought" and expand its application to the greater construction market.
- The companies questioned should be of similar size and nature to the ones that were questioned during the model's formulation, in order to emphasize to the model's functionality (or malfunction) for a certain type of companies, if the results are accurate (or inaccurate), respectively.

The companies that took part in the examination of the model's feasibility were two, and responded in terms of 5 projects each. More specifically, the new questionnaire formed (Questionnaire C in appendix) was filled for each of the 5 projects for each company. This questionnaire required less information regarding the special characteristics of each project, since in this part the critical issues are two:

- The final decision taken by the company (bid/no bid)
- The contractors' assessment grades (depicting the "level of satisfaction" from each factor) that would be used in Equation A, in order to estimate Bik and reach to the model's conclusion.

After the model reached to a conclusion regarding the bid/no bid dilemma, the model's results were compared with the actual (real) decisions taken from the companies, to estimate the model's accuracy in simulating the companies' actual decisions. Following this process for each of the 10 projects questioned, the results were that the model simulated correctly the companies' actual decision in 8 out of 10 projects. Thus, its accuracy can be estimated at 80%.

However, it is a fact that the sample on which the model results were based was considerably limited. Thus, even though the results may be considered as representative of the companies' tenses and strategies, for reasons of future investigation, the model's accuracy needs to be tested in a greater sample, and, in the case of significant inaccuracies, the model's optimisation through adding or eliminating some factors, remains an option.

6.3 Comparison to Wanous's results

As far as it concerns the comparison between the present model's results with Wanous's results, a primary comment is that both models proved to be of similar accuracy. Wanous's model proved 85% accurate in simulating the actual decisions of Syrian contractors, whereas the present one proved 80% accurate in simulating the actual decisions of Greek contractors. It is a fact, though, that even if percentages are quite similar, Wanous's results may be considered more reliable ones since they are based on a bigger sample of projects, both during the model's forming process and during the model's testing process.

However, at this point, a critical issue needs clarification, regarding a significant distinction between the present model and Wanous's one. Wanous's model can be considered strictly *quantitative*, the ultimate goal being to identify the mathematical model required that would be used as a tool in order to analyse the bidding decision process. In order to achieve this goal, much less interest is shown in giving a more detailed picture of how Syrian construction industry works, what the representative profile for each of the companies is, or how the factors identified are explained and analysed.

On the present model, on the other hand, even though the main goal retains its quantitative characteristics and aims to estimate the influential factors for the bid/ no bid dilemma, emphasis is also placed on the *qualitative* nature of the research. This is achieved through detailed information that is given regarding the above stated factors highlighting the process through which the factors were identified and showing the special characteristics that are representative of the way the Greek construction industry functions.

6.4 Conclusions

The present study represents an analysis of bidding processes in the Greek construction industry, identifying the way the industry operates and evolves, as well as the factors that influence the medium-level contractors decisions towards the bid/ no bid dilemma. Through that process, various conclusions were drawn, both of general nature in terms of the scope of the present study, and of specific one through the analysis of the data and the results of the bidding model created.

6.4.1 Scope of the study

Bidding processes, in general, represent a most significant aspect of a company's strategy, able to add value to the company's benefits in terms of growth, profit, or market share. Accurate responsiveness of companies towards the bidding dilemmas usually provides the best initiative for optimizing the company's performance.

As practice has showed, the three main characteristics that traditionally determine bidding decisions in construction are experience, intuition and subjectivity. Contractors usually rely on their experience and their subjective knowledge, making their decision on whether bidding or not, not being based on any specified strategic thinking model, but mostly on their capabilities in terms of identifying the tenders that need to be submitted.

However, that experiential approach on bidding processes resulted in some cases into catastrophic results for certain companies. The reasons could be attributed mostly to the relatively high direct and indirect costs that exist in construction industry, that can result to severe financial losses for a company after undertaking an unsuccessful project. This considerable uncertainty created the necessity of the development of structural solutions that would aid to the analysis of the tendering situation through a mathematical structural model, in order to provide more accurate bidding decisions and estimations (Smith, 1995).

Literature has shown that various structural models have been developed in an effort to reduce this uncertainty. However, in their majority they proved incapable of representing a tool that would be seriously taken into consideration by contractors as a guide for their decision. The reasons for the models' inadequacies varied, however they could be summarised to the following strategic concept: The greatest task in this specific subject is the successful combination of "hard" approaches that mostly measure mathematical figures, such as meeting specific cost, time and quality standards of each project as set in the tender under submission, with "soft" aspects like human decisions, relationships with clients and contractors' behaviors that have a considerable degree of uncertainty. Thus, strictly structural models have proven inadequate in terms of facing real-life situations, translating the model parameters into real life, and, finally, optimizing the companies' performance (Rothkopf and Harstad, 1994).

Taking the above into consideration, the present study aims to underline the importance and the level of contribution of each criteria element included in the model analysis, based on the combination of methodologies of quantitative theories like the Wanous et al, (2000), parametric model, and the experience and judgment of qualified cost engineers, approaching the issue also from its qualitative point of view.

6.4.2 Basic analysis results

The model developed represents, as stated, an approach that maintains its quantitative character, however emphasizing also to the qualitative aspect of the research. The value of a structured, mathematical approach is highlighted through the estimation of the factors that influence the bid / no bid dilemma along with the effect each has on the decision. During this process, multiple conclusions were drawn, and in multiple stages of the process.

In the first part, where Greek construction industry is described thoroughly based on the significant discrimination between public and private projects, the model's necessity was mostly observed in private projects than in public ones, a fact relatively contradictory to the initial beliefs. The initial thought was, that in public projects, with

their totally predefined characteristics (especially after the "mathematical law" was withdrawn), companies would find the use of a "hard", mathematical approach, of greater usage. In private projects, on the other hand, the concept initially was that the model would be of reduced importance, due to the subjectivity that is included in the bidding process, mostly since contractor-client relationships intrude and modulate the process and, as known, strategic relationships usually substitute mathematical approaches.

However, the survey showed that in practice things are opposite. According to the contractors questioned, a mathematical approach is more appropriate for private projects, since, according to them, things are more clear and transparent in that sector. The explanation for that statement is that private sector may have no written and specified rules, however it operates under the norms of competition, which represents the healthiest environment in which a company can perform and achieve growth. Under this prism, a "hard" tool is of significant importance, aiding to the standardization of processes. In public projects, in the other hand, rules may be legally defined in details; however non-measurable parameters like bribing and corruption may interfere and affect the accuracy of the "hard" models' results, no matter how well they may be structured.

Another significant conclusion drawn from the model's analysis concerns certain characteristics of the Greek construction industry derived from the most influential factors on bidding decisions, as found in table 5, and explained thoroughly in section 5.2.2. From that table, the industry in Greece shows as operating through a relatively opportunistic behavior, stating as the most influential factors the *financial capability of the client* and the *Past profit in projects of similar nature*, reducing the value of theoretically very significant factors, like *fulfilling the to-tender conditions imposed by the client*, which, as depicted in table 1, is of primary importance in the Syrian construction industry.

Additionally, through the analysis of the model it is concluded that Greek construction firms, and especially medium-level ones, (like the ones that were

questioned in the present study), appear to have an aggressive policy towards bidding processes, aiming to bid in as much auctions as they can. This conclusion is derived from many parts of the research, such as table 5, where negative factors are ranked with a relatively lower significance than in the Syrian construction industry, and in figure 8, where it is shown that in the majority of auctions, the bidding decision is preferred. This fact, however, has resulted to financial problems for many firms, since their constant effort to submit tenders and undertake new projects resulted to several failures that were basically attributed to ineffective tendering strategies.

Consequently, the value of a structural approach like the one stated in the present study is additionally underlined for Greek contractors, since the conditions of the industry may demand the application of guiding tools that would achieve controlling processes, reducing opportunistic behaviors, and optimizing the companies' performance.

6.5 Limitations of the study - Recommendations for further research

The present study, as stated, represents a useful tool for contractors, aiding them in their bidding decision. However, there exist some limitations of the model created, as well as some recommendations that are proposed for the model's optimisation.

Firstly, as stated, the model is mostly based and tested in private projects, rather than public ones. Even though the option of referring to more projects of the public sector was open to the contractors, the contribution of public projects to the formation of the model was not significant. Thus, a clear recommendation is a further examination of the model's validity in public projects, through a possible creation of two models, one of each sector, with different key factors and characteristics.

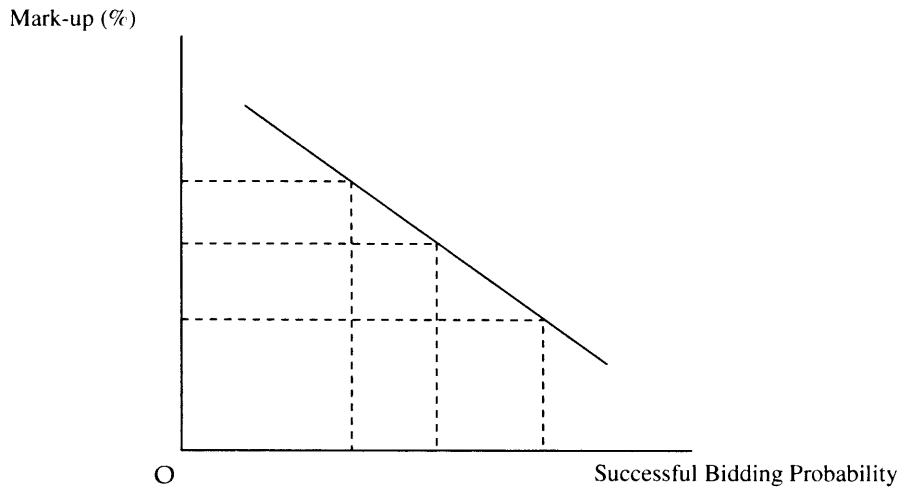
Following, the model's formulation and testing was focused on the decision outcome, judging from the contractor's decision, whether he decided to bid or not, not examining the success of the project undertaken. Thus, in later research, this

parameter should be taken into consideration in order to examine the model's validity as a bidding tool.

Also, the model's optimisation is proposed, through sensitivity analysis that is required in order to simplify as much as possible the final bidding model by reducing the number of factors required. However, model's simplification should be done taking care of all parameters that might influence the process, to avoid negative effects on model's accuracy. A critical statement at this point is that accuracy may not only be increased through factors' elimination. A possible way of increasing accuracy may be through the addition of factors like the ones with relative importance below 50%, as depicted in table 5. In that way, however, simplification of the model is not achieved, but increased accuracy can be considered much more critical as an issue.

Another recommendation can be the model's expand to the development of one general model that will include, apart from the decision towards the bid/no bid dilemma, information regarding the percentage of mark-up estimation that needs to be added to the average cost of the company's tender, in order to achieve the optimal balance between the mark-up added and the successful bidding probability of the company, as depicted in figure 11 below.

Figure 11: The gross profit maximising strategy



(Source: Gruneberg and Ive, 2000)

Finally, the model needs further testing in a bigger sample of projects in order to be generalised. As stated, the model was formed after the questionnaires filled regarding 25 projects in total, and tested in an additional amount of 10. These numbers may be enough in order to provide a good initiative and structure, however the model's further testing and re-evaluating is necessary in order to achieve its utilisation as a tool of critical importance for construction companies. So far, the model's results are experimental, thus, they can only have a supplementary role in the decision making process, and not a primary one substituting the contractor's critical evaluation of the situation.

6.6 Summary

A systematic and realistic model, which can gain acceptance in practice, dealing optimally with different bidding situations, and assisting the contractors in reaching the correct bid/no bid decisions, was presented. This bidding model was based on the findings of a questionnaire survey undertaken in 5 Greek construction companies, on a total number of 25 projects. The process involved both structured interviews and filling of questionnaires by the contractors, in order to come to results regarding the operating procedures of Greek construction firms and the key factors that influence their bidding decisions.

The ultimate result of the research was to estimate all critical factors, and include them as parameters into a mathematical equation (equation A) that would have as the only unknown variables, the contractor's assessments towards a specific project. After those would be added, the model would be able to come to an accurate conclusion regarding the decision needed to be made by the contractor. The model, after formed, was tested against another 10 real-life projects and proved 80% accurate in simulating the actual decisions made by the contractors.

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APPENDIX

COMPANY'S PROFILE

Stage A

1. Company's name

.....
.....
.....

2. Incorporation date

.....

3. Company's main activities

a. Nature of projects the company is focused to:

- o Public sector
- o Private sector

b. Type of projects the company is focused to:

- o Residential buildings
- o Commercial buildings
- o Infrastructure (heavy/highway projects)
- o Industrial buildings
- o Other types of projects

4. Total number of employees (full-time occupied)

- o 1-10
- o 10-20
- o 20-50
- o More than 50

5. Number of engineers (full-time occupied)

- o 1-10
- o 10-20
- o 20-50
- o More than 50

6. Grade of construction certificate

- o 1st grade
- o 2nd grade
- o 3rd grade
- o 4th grade
- o 5th grade
- o 6th grade
- o 7th grade

7. Revenues during the year 2006 (approximately)

- o Up to 500,000 Euros
- o Between 500,000 and 2,000,000 Euros
- o Between 2,000,000 Euros and 5,000,000 Euros
- o More than 5,000,000 Euros

8. Profit during year 2006 (approximately)

- o Up to 100,000 Euros
- o Between 100,000 and 500,000 Euros
- o Between 500,000 and 2,000,000 Euros
- o More than 2,000,000 Euros

9. Company's tendering policy

a. Number of invitations to tender during year 2006

- o 1-5
- o 5-10
- o 10-15
- o 15-20
- o More than 20

b. Of which, the total number of tenders submitted was

- o 1-5
- o 5-10
- o 10-15
- o 15-20
- o More than 20

c. And the number of competitions won (number of projects undertaken) was

- o 1-5
- o 5-10
- o 10-15
- o 15-20
- o More than 20

Stage B

Following, there is a table that depicts the "level of importance" for each of the factors that are considered during a company's decision process.

In Table A is required your assessment grade for each of the factors on a scale from 1 to 6, where

- **Grade 1** represents a criterion of almost zero importance in the company's decision

and

- **Grade 6** represents a criterion of undoubted importance

Table A: Factors considered during a company's decision process

CRITERION Fi	**IMPORTANCE Ibi and Ibj**					
	1	2	3	4	5	6
Fulfilling the to-tender conditions imposed by the client						
Financial capability of the client						
Relations with and reputation of the client						
Project size (On an economical basis) (on an economical basis)						
Availability of time for tendering						
Availability of capital required						
Public objections						
Availability of critical materials required						
Availability of skilled labour						
Availability of critical equipment required						
Current work load						
Site accessibility						
Site location						
Expected quantity and quality of competitive bids						
Local climate						
Specific features that provide competitive advantage to firm						
Relations with other contractors and suppliers						
Past experience/profit in projects of similar nature						
Risks expected						

PROJECT'S PROFILE

Stage A

1. **Project's nature:**

   - o Public project
   - o Private project

2. **Project's type:**

   - o Residential Housing
   - o Commercial housing
   - o Infrastructure (heavy/highway projects)
   - o Industrial
   - o Other types of projects

3. **Auction procedure:**

   a. Type:

   - o Selective
   - o Non Selective

   b. Process:

   - o Open tendering process, bids begin high and descend, permission to re-bid
   - o Closed and sealed tendering process, no permission to re-bid, lowest bidder wins

4. **Number of competitors:**

   - o 1-5
   - o 5-10
   - o More than 10

5. **Decision taken:**

   - o Bid
   - o No bid

   Explanation for decision:

   .....
   .....
   .....
   .....

6. **If decision to bid was taken, was the competition won?**

- o Yes
- o No

If "Yes", was the project financially successful?

- o Not at all, our company experienced losses
- o Marginally successful
- o Very successful

Explanation for project's success/loss:

.....

.....

.....

7. **If decision to bid was not taken, what was the company's position in the order?**
(e.g. 2nd lowest bid)

.....

8. **General comments regarding the project**

.....

.....

.....

.....

.....

Stage B

Following, there are two tables that depict the "level of satisfaction" for each of the critical factors that depict the influence each factor has to the decision process.

- In Table B is required your grade for each of the positive factors on a scale from 1 to 6, where
  - **Grade 1** stands for a totally negative influence of the factor (that discourages the company from bidding), and
  - **Grade 6** stands for a totally positive influence that may even highlight your company's competitive advantage for that specific project.

It is also asked to define (according to your subjective knowledge) a "kill value" **(NBi)** for each factor, which depicts the value **below** which you would immediately arrive to a "no bid" decision for the project under discussion

- In Table C is required your grade for each of the negative factors on a scale from 1 to 6, where

  - **Grade 1** stands for a totally positive influence of the factor (that guides to a bidding decision)
  - **Grade 6** stands for a totally negative influence (that discourages the company from bidding)

  It is also asked to assess (according to your subjective knowledge) a "kill value" **(NBj)** for each factor, which depicts the value **above** which you would immediately arrive to a "no bid" decision for the project under discussion

Table B: Influence of positive factors to the company's decision

CRITERION Fi	INFLUENCE						KILL VALUE NBi
	1	2	3	4	5	6	
Fulfilling the to-tender conditions imposed by the client							
Financial capability of the client							
Relations with and reputation of the client							
Availability of capital required							
Availability of critical materials required							
Availability of skilled labour							
Availability of critical equipment required							
Expected quantity and quality of competitive bids							
Specific features that provide competitive advantage to firm							
Relations with other contractors and suppliers							
Past experience/profit in projects of similar nature							

Table C: Influence of negative factors to the company's decision

CRITERION Fi	INFLUENCE						KIILL VALUE NBj
	1	2	3	4	5	6	
Project size (On an economical basis)							
Risks expected							
Site location							
Expected quantity and quality of competitive bids							

MODEL'S VALIDATION

1. **Project's nature:**

   - o Public project
   - o Private project

2. **Project's type:**

   - o Residential Housing
   - o Commercial housing
   - o Infrastructure (heavy/highway projects)
   - o Industrial
   - o Other types of projects

3. **Auction procedure:**

   a. Type:

   - o Selective
   - o Non Selective

   b. Process:

   - o Open tendering process, bids begin high and descend, permission to re-bid
   - o Closed and sealed tendering process, no permission to re-bid, lowest bidder wins

4. **Decision taken:**

   - o Bid
   - o No bid

5. **If decision to bid was taken, was the competition won?**

   - o Yes
   - o No

Following, there are two tables that require your assessment grade **CAi** and **CAj** in terms of the "level of satisfaction" for each of the critical factors stated.

- In Table D is required your assessment grade for each of the positive factors on a scale from 1 to 6, where
  - **Grade 1** stands for a totally negative influence that this factor had (that discouraged your company from bidding), and
  - **Grade 6** stands for a totally positive influence that this factor had (guiding to a bidding decision).

- In Table E is required your assessment grade for each of the negative factors on a scale from 1 to 6, where

  - **Grade 1** stands for a totally positive influence that this factor had (guiding to a bidding decision)
  - **Grade 6** stands for a totally negative influence (that discourages your company from bidding)

Table D: Influence of positive factors to the company's decision

CRITERION Fi	**ASSESMENT GRADE CAi**					
	1	2	3	4	5	6
Fulfilling the to-tender conditions imposed by the client	.					
Financial capability of the client						
Relations with and reputation of the client						
Availability of capital required						
Availability of critical materials required						
Availability of skilled labour						
Availability of critical equipment required						
Expected quantity and quality of competitive bids						
Specific features that provide competitive advantage to firm						
Relations with other contractors and suppliers						
Past experience/profit in projects of similar nature						

Table E: Influence of negative factors to the company's decision

CRITERION Fi	**ASSESMENT GRADE CAj**					
	1	2	3	4	5	6
Project size (On an economical basis)	.					
Risks expected						
Site location						
Expected quantity and quality of competitive bids						